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THE STELLAR SYSTEM Σ 3050 = ANDROMEDAE 37
(Burnham's *G. C.*, No. **12675**)

By Eric Doolittle

The following investigation was undertaken in consequence of the interesting note by Dr. J. S. Plaskett in *A. S. P.*, No. 179. The velocity in the line of sight of each of the components was measured on five nights by him, with the new Brashear 72-inch reflector; it was found that the system is approaching us, but that the components are moving with slightly different velocities: the velocity of *A* in the line of sight is 4.6 miles a second, while that of *B* is but 2.6 miles a second. Dr. Plaskett regards it as so probable as to be almost a certainty that the two stars are physically connected.

As will be noticed from the tabulation below, the system has been many times measured with the micrometer. The number of measures total no less than 206 nights. The pair is a very easy one, the two components being of equal magnitude (6.58 according to Dr. Plaskett), and they are widely separated at all times; the errors of measurement should therefore be small. It was hoped that a careful investigation of this material would give definite evidence of the binary character of the pair.

The individual observations are as follows:

Date	θ_0	ρ_0	θ_0-θ_c	ρ_0-ρ_c	Observer	Nights
1821.92	188°.4	5″.26	−0°.6	+0″.93	Sh	2*n*
1830.04	189 .7	4 .37	−0 .9	−0 .15	Sh	1*n*
1830.73	189 .0	4 .07	+1 .4	−0 .03	Dawes	2*n*
1832.65	191 .0	3 .78	−0 .1	−0 .26	Σ	3*n*
1837.03	191 .7	4 .14	−0 .3	+0 .20	Dawes	2*n*
1843.81	193 .0	3 .65	−0 .5	+0 .14	Dawes	1*n*
1848.10	194 .9	3 .82	+0 .4	+0 .16	Maedl.	8*n*
1849.31	194 .5	3 .56	−0 .3	−0 .07	Dawes	2*n*
1855.49	196 .4	3 .55	−0 .1	+0 .07	Δ	7*n*
1855.98	196 .6	3 .50	±0 .0	+0 .03	Morton	3*n*
1857.51	196 .4	3 .44	−0 .6	+0 .01	Secchi	3*n*
1862.20	198 .2	3 .34	+1 .2	+0 .02	Maedl.	8*n*
1864.99	199 .6	3 .17	+0 .4	−0 .08	Δ	11*n*
1868.56	200 .7	3 .16	+0 .3	±0 .00	Duner	3*n*
1871.41	*201 .3	3 .00	±0 .0	−0 .10	Δ	6*n*
1875.70	203 .0	3 .06	+0 .1	+0 .06	Duner	3*n*
1876.06	203 .6	3 .09	+0 .6	+0 .09	Seab.	1*n*
1876.85	202 .2	3 .08	−1 .1	+0 .09	Doberck	3*n*
1880.11	204 .9	3 .05	+0 .4	+0 .14	Jed.	3*n*
1883.77	206 .3	3 .02	+0 .3	+0 .18	En.	6*n*
1885.91	206 .0	2. 61	−0 .9	−0 .17	de Ball	2*n*
1886.81	207 .3	2 .87	±0 .0	+0 .11	H Σ	2*n*
1887.92	206 .8	2 .77	−1 .0	+0 .01	Hall	2*n*
1889.92	208 .6	3 .08	−0 .1	+0 .36	Maw	3*n*

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*Lewis has here 202°.3

Date	θ_0	ρ_0	$\theta_0-\theta_c$	$\rho_0-\rho_c$	Observer	Nights
1892.95	210 .0	2 .60	−0 .1	−0 .04	Jones	2*n*
1893.83	211 .1	2 .73	+0 .6	+0 .11	Glase.	4*n*
1894.13	210 .4	2 .86	−0 .3	+0 .24	Knorre	3*n*
**1894.30	210 .5	2 .66	−0 .2	+0 .04	Comst.	4*n*
1894.66	210 .6	2 .64	−0 .3	+0. 03	Collins	4*n*
1894.72	212 .2	2 .86	+1 .3	+0 .15	Niesten	2*n*
1897.02	213 .9	2 .70	+1 .8	+0 .14	Seabr.	2*n*
1897.21	212 .2	2 .57	±0 .0	+0 .01	Bowyer	5*n*
1897.92	212 .5	2 .67	−0 .1	+0 .13	Maw	3*n*
1898.84	214 .1	2 .40	+1 .1	−0 .12	Bryant	1*n*
1898.91	212 .4	2 .55	−0 .7	+0 .05	Aitken	2*n*
1899.83	214 .3	2 .40	+0 .8	−0 .10	Lewis	1*n*
1900.83	214 .3	2 .45	+0 .2	−0 .03	Doberck	2*n*
1901.10	214 .2	2 .47	±0 .0	−0 .01	Bowyer	4*n*
1902.59	213 .2	2 .32	−1 .8	−0 .13	Thiele	1*n* (Phot.)
1902.61	215 .8	2 .79	+0 .8	+0 .34	Thiele	1*n*
1902.64	214 .9	2 .46	−0 .2	+0 .01	Hussey	2*n*
1902.92	214 .5	2 .67	−0 .7	+0 .22	Washn.	2*n*
1902.98	214 .1	2 .50	−1 .1	+0 .05	Scott	2*n*
1903.11	214 .8	2 .37	−0 .5	−0 .07	Bowyer	3*n*
1903.47	217 .1	2 .26	+1 .6	−0 .18	Furner	3*n*
1903.60	216 .0	2 .46	+0 .4	+0 .01	Lewis	4*n*
1903.64	216 .8	2 .36	+1 .2	−0 .07	Doberck	1*n*
1903.69	212 .6	2 .44	−3 .0	+0 .01	Thiele	1*n* (Phot.)
1903.93	215 .1	2 .25	−0 .7	−0 .18	Bowyer	3*n*
1905.05	216 .4	2 .61	±0 .0	+0 .20	Espin	2*n*
1905.21	215 .4	2 .34	−1 .1	−0 .07	Lohse	2*n*
1907.64	217 .8	2 .57	−0 .1	+0 .20	Lau	2*n*
1907.67	216 .3	2 .48	−1 .6	+0 .11	Lap.-Ja.	2*n*
1908.07	216 .5	2 .56	−1 .6	+0 .20	Furner	1*n*
1908.33	218 .5	2 .25	+0 .2	−0 .11	Biesbr.	4*n*
1908.66	215 .4	2 .29	−3 .1	−0 .06	Bowyer	1*n*
1908.66	220 .3	2 .30	+1 .8	−0 .05	Lau	1*n*
1908.75	220 .2	2 .36	+1 .7	+0 .01	Doberck	3*n*
1909.68	218 .8	2 .49	−0 .3	+0 .16	Lap.-Ja.	1*n*
1909.68	220 .4	2 .27	+1 .3	−0 .06	Lau	1*n*
1910.52	219 .7	2 .27	+0 .1	−0 .05	Doolittle	3*n*
1910.80	219 .7	2 .27	−0 .1	−0 .05	Voute	4*n*
1911.67	220 .1	2 .46	−0 .2	+0 .15	Buch.-And.	1*n*
1911.68	217 .6	2 .44	−2 .7	+0 .13	Lap.-Ja.	2*n*
1911.81	221 .1	2 .16	−0 .7	−0 .14	Biesbr.	6*n*
1911.93	222 .9	2 .45	+2 .4	+0 .15	Chapman	1*n*
1912.58	221 .9	2 .24	+1 .0	−0 .05	Chapman	1*n*
1912.73	221 .4	2 .24	+0 .4	−0 .05	Voute	4*n*
1912.73	221 .1	2 .19	+0 .1	−0 .10	Phillips	3*n*
1912.74	221 .4	2 .33	+0 .3	+0 .04	Aitken	1*n*
1912.86	221 .4	2 .22	+0 .3	−0 .07	Doberck	3*n*
1914.67	222 .4	2 .15	+0 .2	−0 .11	Phillips	3*n*
1914.83	221 .8	2 .21	−0 .5	−0 .05	F. W. Brown	4*n*
1914.85	221 .5	2 .05	−0 .8	−0 .21	Leavenw.	4-3*n*

From these 74 observations there were first formed the following seven mean places, the numbers in parentheses indicating the weights ascribed to the various observations. The corrections for precession have been applied, but these are here very small: mean places earlier than 1853.6 are diminished by 0°.01 and those later than 1906.4 are increased by 0°.01.

**Lewis has here 1895.30; there is also an error in the *G.C.*, where the date is given 1894.20

1839.191	192°.29	3″.83	(D1. Σ3, D1, D½, Ma2, D1)
1863.570	198 .82	3 .27	(Δ3, M1, Se1, Ma2, Δ5, Du1, Δ3)
1882.759	205 .49	2 .97	(Du1, S½, Do1, J1, E1, B½, HΣ1, Ha1, Maw1)
1896.229	211 .93	2 .65	(J½, Gl1, K1, C1, Con1, N1, S½, B1, M1, B½, A1, L½, Do½)
1903.343	214 .70	2 .41	(B1, T⅛, T⅛, Hu1, W½, S½, B1, F1, L1, Do¼, T0, B1, Es½, Lo1)
1910.154	219 .60	2 .30	(L¼, L-J¼, F⅛, Bi 1, Bo⅛, L¼, Do¼, L-J⅛, L⅛, D1, V1, B-A¼, L-J⅛, Bi1, C⅛, C⅛)
1913.630	221 .57	2 .20	(Each observation given weight 1)

These seven places were next plotted and a straight path drawn thru them, the elements of the path being improved by a least-square adjustment with the usual formulas. The final (third) adjustment led to the following values:

$$\left.\begin{aligned} \alpha &= 342^\circ.14 \\ p &= 1''.9583 \\ \mu &= 0''.029423 \\ T &= 1953.006 \end{aligned}\right\} \begin{array}{l}\text{(Mean Equator and} \\ \quad\text{Equinox of 1880.0)}\end{array}$$

The seven mean places are almost perfectly represented by these elements, the $[vv]$ for θ being but 0°.63, and for ρ but 0″.031. When the computed places are compared with the individual observations, we obtain columns four and five of the above tabulation: these show some evidence of curvature of path since positive residuals in distance predominate from 1837 to 1900, but the evidence is hardly as conclusive as could be wished.

If we determine the velocities in the path, regarded as a straight line, we obtain the following results:

	v
1839-1863	0″.0303
1863-1882	0 .0288
1882-1896	0 .0309
1896-1914	0 .0283

There is thus no evidence of a variation in velocity, nor, tho the stars are so rapidly drawing together, is there any evidence of an approach to periastron.

The proper motion of the system, according to Boss, is 0″.106 in 220°.5; the relative motion of *B* with regard to *A*, as found in the present investigation, has the very different value, 0″.029 in 342°.1. In conclusion, it may therefore be said that while it is very probable, and indeed almost certain, that the two components are physically connected, the micrometric measures give but little definite evidence of such a connection. As the relative velocity has remained practically unchanged for a hundred years, it is not to be expected that the character of the motion will soon suddenly change, and consequently frequent observations on this pair are at this time unnecessary.

The following brief ephemeris will probably represent the motion for the next few years:

	θ	ρ
1918.0	224°.40	2″.21
1920.0	225 .76	2 .19
1922.0	227 .16	2 .16

Burnham in 1909 has measured a 12.8 magnitude star, 82″ distant from *A*.

The Flower Observatory,
March 16, 1919.